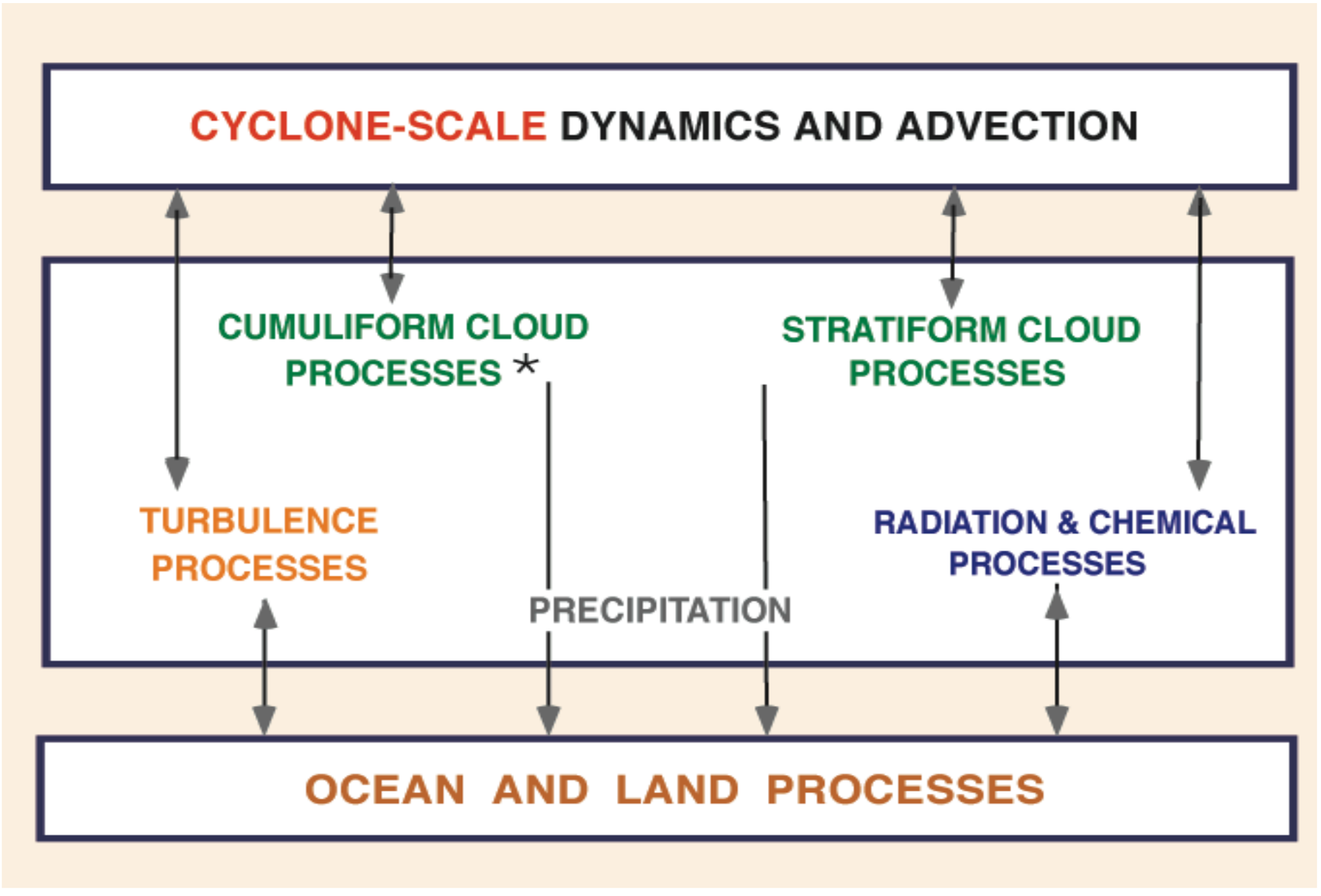
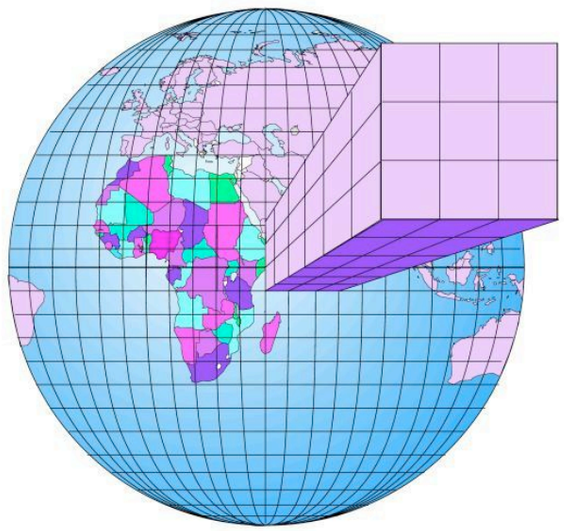
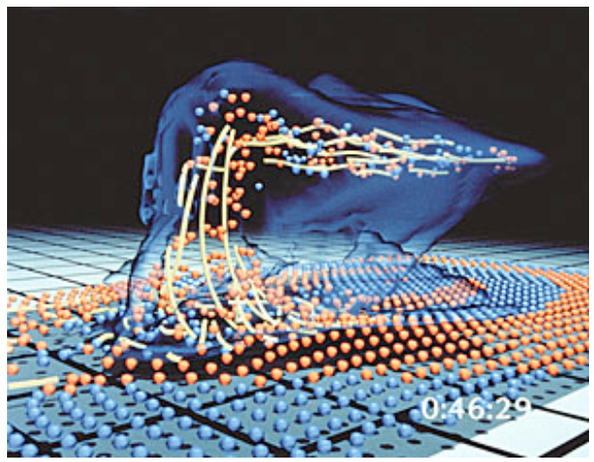
Modeling in the Age of GPM

Modeling in the Age of TRMM



Cloud-scale interactions are not included.

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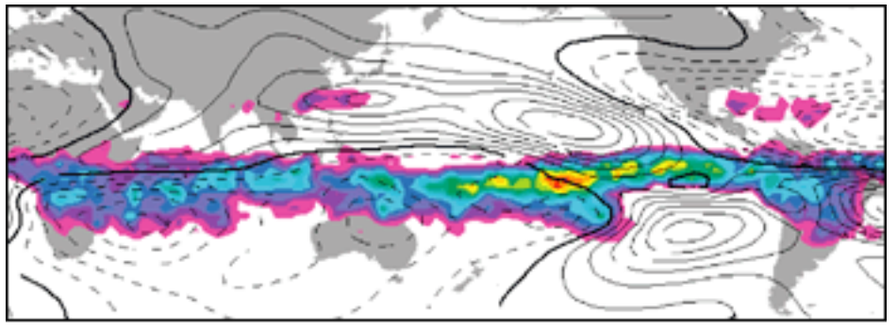
Latent Heat (°C/day)
0
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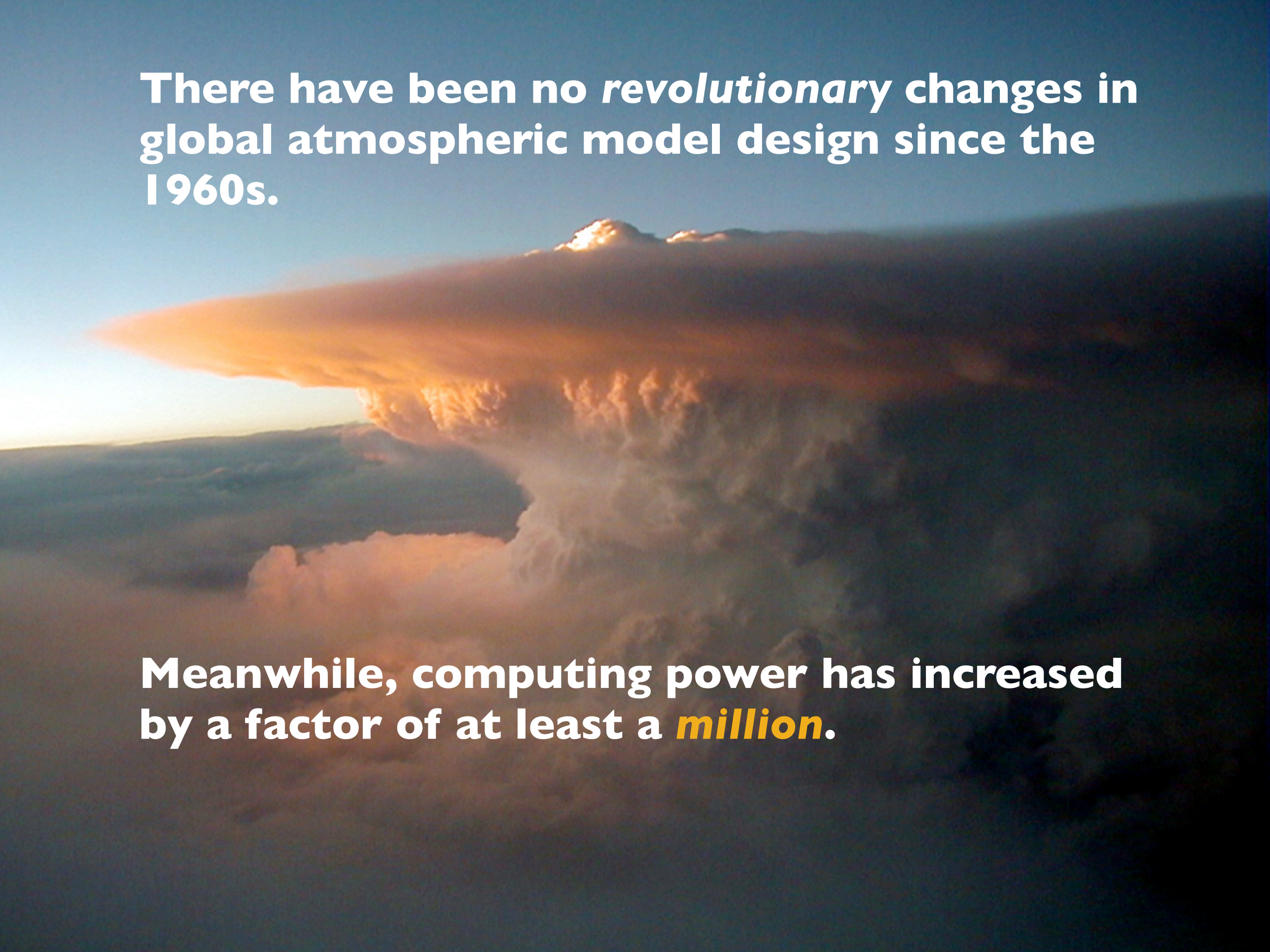
6



There have been no *revolutionary* changes in global atmospheric model design since the 1960s.

Meanwhile, computing power has increased by a factor of at least a *million*.

What did we do with that million?

- Model resolution has increased.
  - The horizontal resolution of climate models has quadrupled (at most).
  - The number of layers has tripled.
- More processes have been introduced.
- Parameterizations have become a little more elaborate.

All of this accounts for (at most) a factor of 1000.

How about the other 1000?

- Higher resolution for NWP (but not for climate)
- Longer runs
- More runs

So, what about the next million?

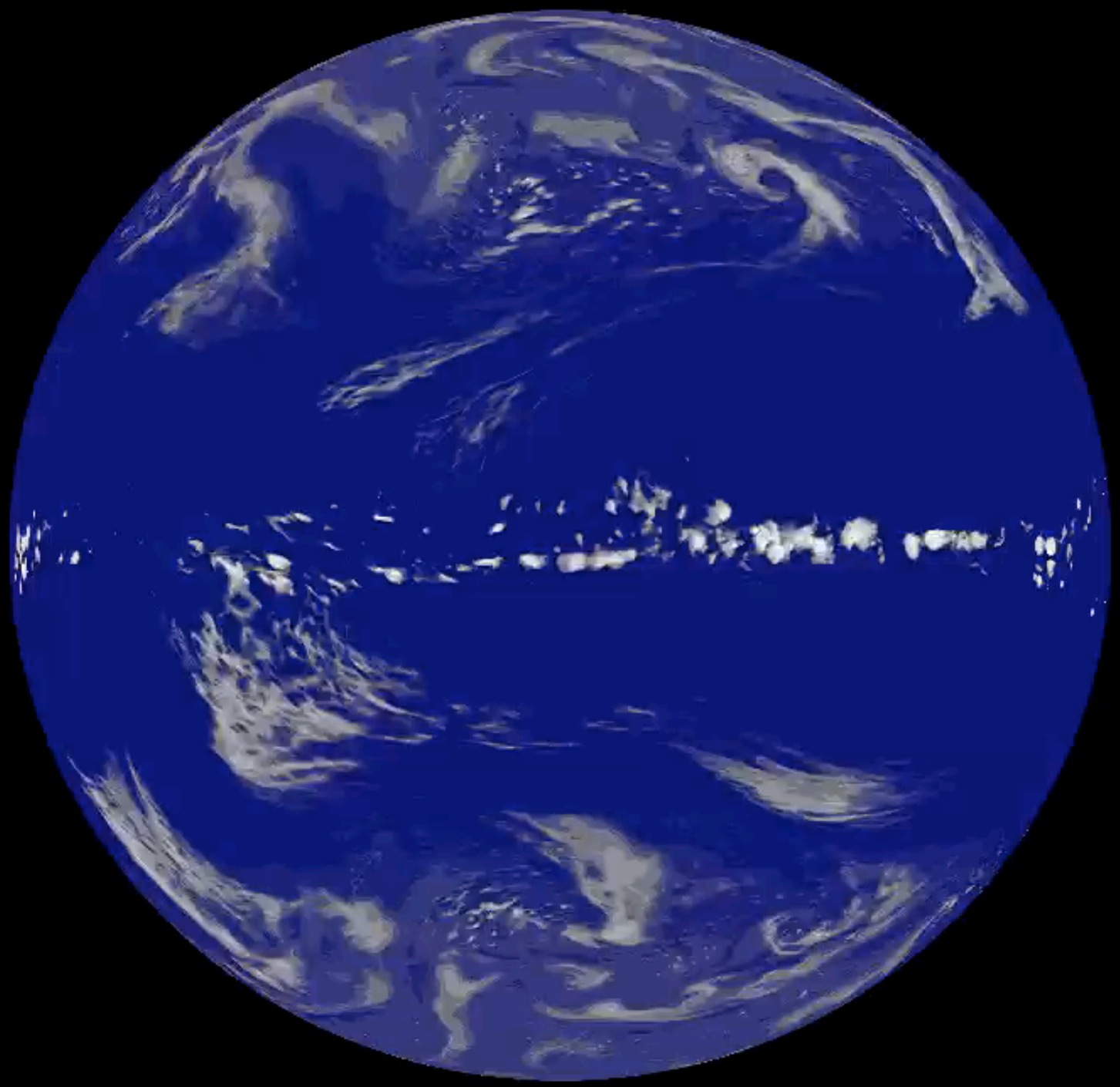
Dreaming of a global CRM (GCRM)

Current climate-simulation models typically have on the order of 10^4 grid columns, averaging about 200 km wide.

A global model with grid cells 2 km wide will have about 10^8 grid columns. The time step will have to be roughly 10^2 times shorter than in current climate models.

The CPU requirements will thus be $10^4 \times 10^2 = 10^6$ times larger than with today's lower-resolution models.

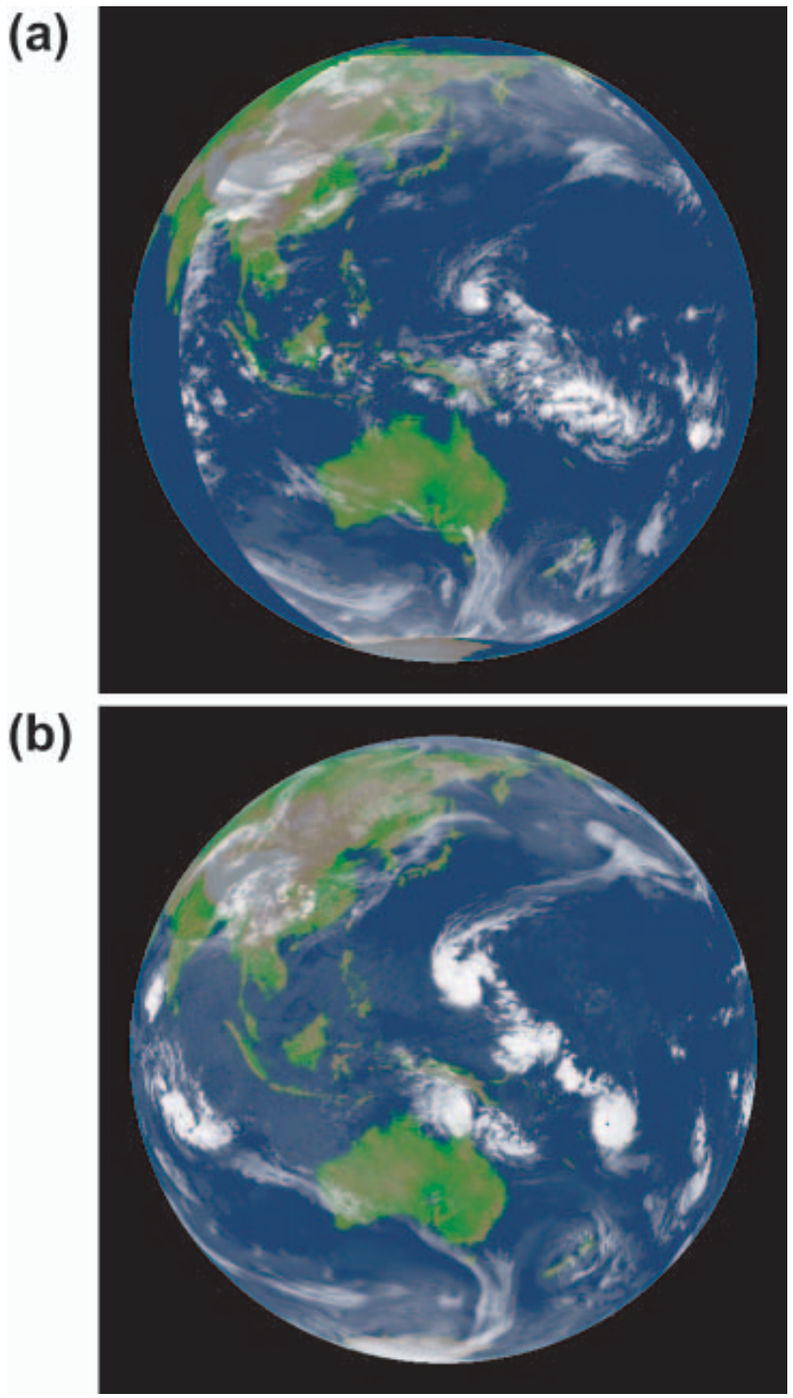
A Dream No More



Hiroaki Miura

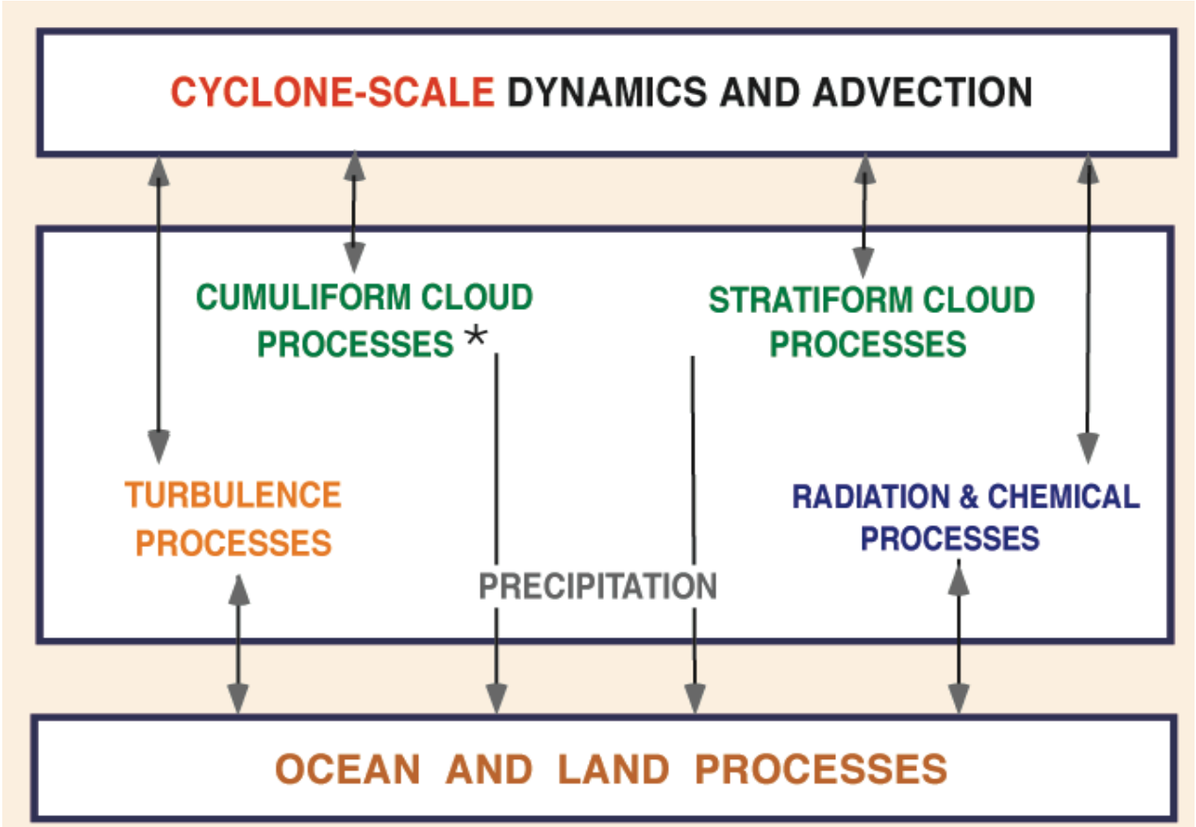
The World's First GCRM

- 3.5 km cell size, ~10^9 total cells
- ~ 1 TB to record model state
- 15-second time step
- ~ 1 TF-day per simulated day

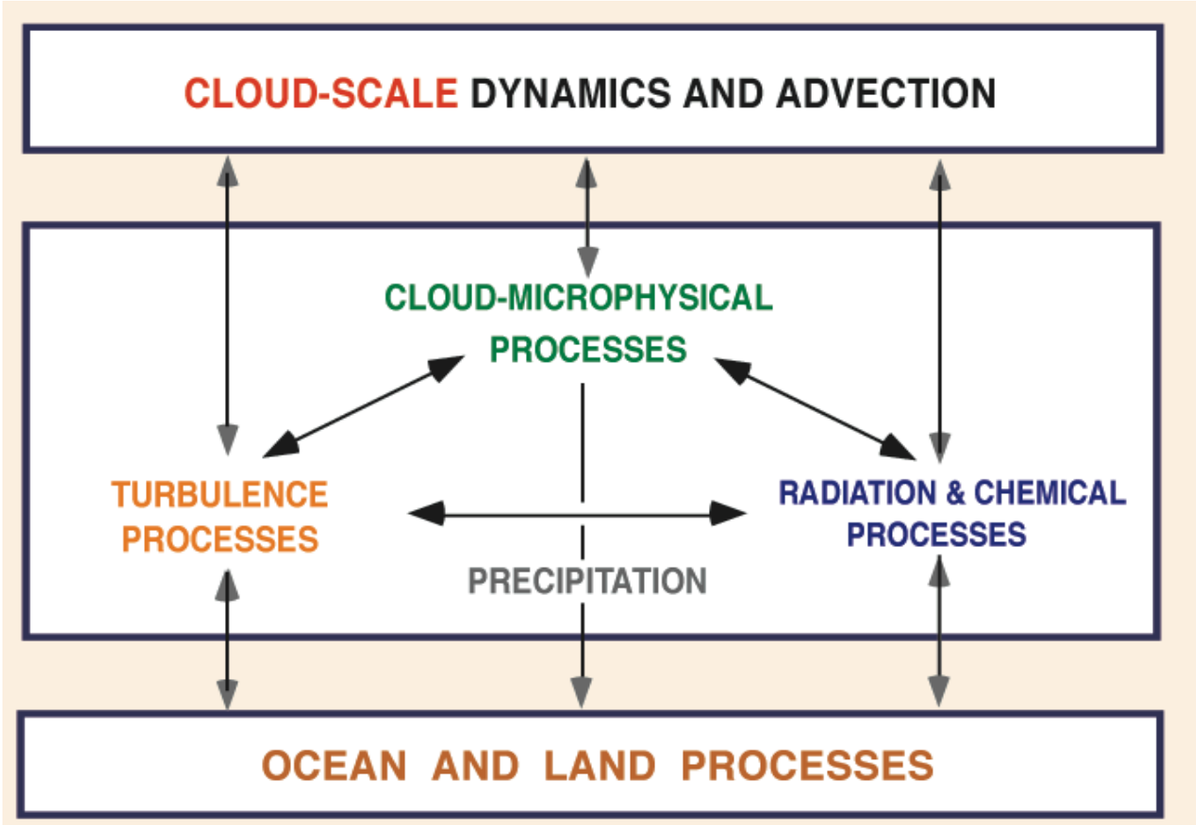


Modeling in the age of GPM

Conventional GCM



GCRM



What do we get?

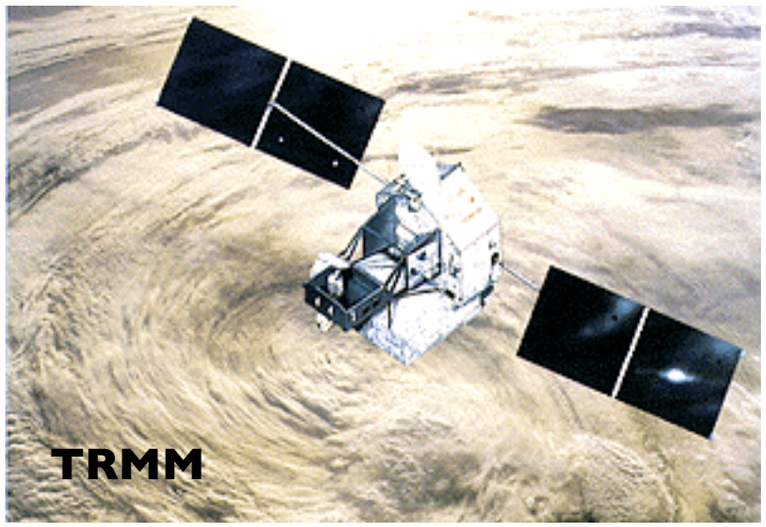
- Explicit deep convection, including mesoscale organization (e.g., squall lines), downdrafts, anvils, etc.
- Explicit fractional cloudiness
- Explicit cloud overlap in the radiative sense
- Explicit cloud overlap in the microphysical sense
- Convective enhancement of the surface fluxes
- The option to do multi-dimensional radiative transfer
- Convectively generated gravity waves

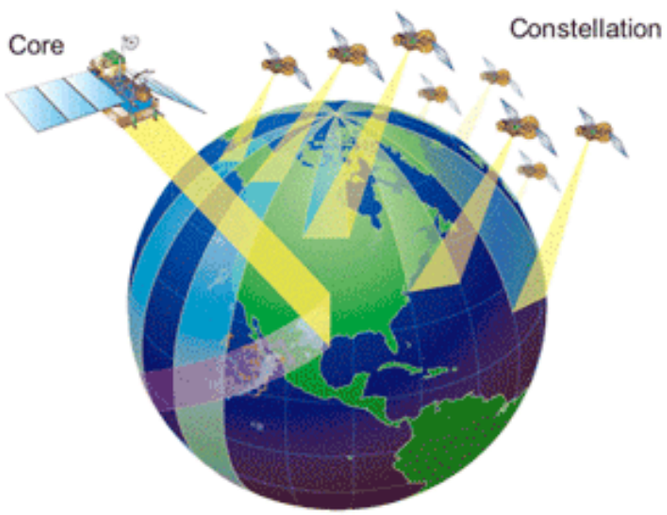
What do we get? 2

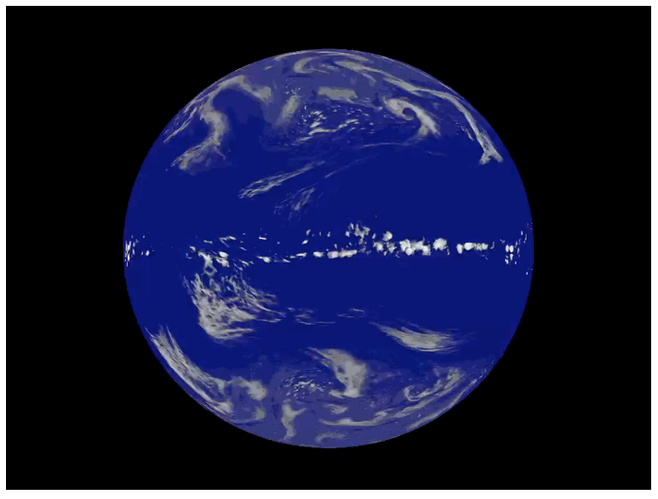
- **The ability to compare global model results on the statistics of mesoscale and microscale cloud organization with observations on the same scales**

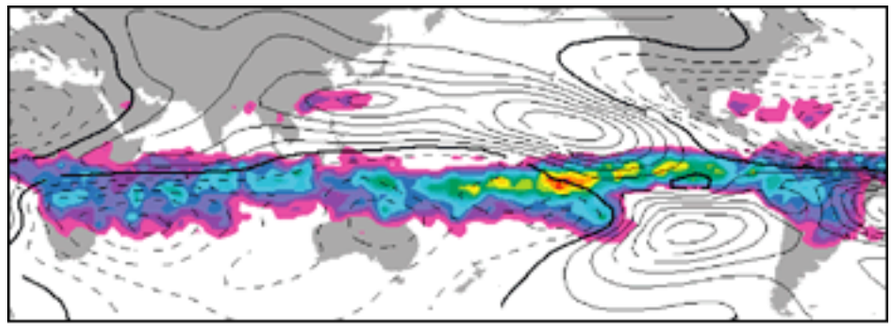
- **The ability to assimilate cloud statistics based on high-resolution observations**

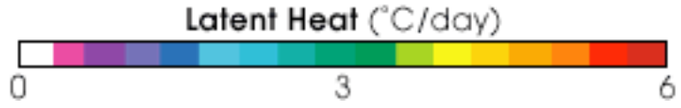
- **The ability to compare GCRM results to results obtained with conventional parameterizations**




Core
Constellation



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